

VOLUME 4. AIRCRAFT EQUIPMENT AND OPERATIONAL AUTHORIZATIONS

CHAPTER 1. AIR NAVIGATION, COMMUNICATIONS, AND SURVEILLANCE

SECTION 4. CLASS II NAVIGATION

111. GENERAL.

A. This section provides concepts, direction, and guidance, which should be used by FAA inspectors to evaluate and approve or deny requests for authorization to conduct Class II navigation operations not previously approved for a particular operator. It also amplifies the general concepts, direction, and guidance provided in section 1 of this Order. Specific “standard practices” are provided in this section for evaluating Class II navigation operations using navigation systems that, within particular areas of en route operation, have well known operational characteristics and limitations. When an operator requests initial approval to conduct Class II navigation using a special means of navigation or in areas not addressed by these standard practices, the Principal Operations Inspector (POI) must forward a request for direction and guidance to AFS-400 with a copy to the Regional Flight Standards Division.

B. Class II navigation is any en route flight operation or portion of a flight operation that is not Class I navigation. Any operation or portion of an en route operation is Class II navigation if it takes place outside the officially designated operational service volumes of International Civil Aviation Organization (ICAO) standard ground-based navigational aids (NAVAIDs), such as VHF omni-directional range (VOR), VOR/distance measuring equipment (DME), and non-directional beacon (NDB). Class II navigation is dependent on the use of a Long Range Navigation System (LRNS). An LRNS may be satellite-based (e.g., Global Positioning System (GPS)), self contained (e.g., Inertial Reference System (IRS)), or referenced to ground stations (e.g., LORAN-C). Additional information on the concept of Class II navigation is provided in sections 1 and 2. The various types of Class II navigation and the evaluation and approval or denial processes for these specific types are discussed in the following paragraphs.

115. IFR CLASS II NAVIGATION. Instrument flight rules (IFR) Class II navigation is any Class II navigation operation conducted under IFR. The primary generic IFR Class II navigation requirements are identical to the generic IFR Class I navigation requirements discussed in paragraph

81 (check reference). However, in many cases, the means of navigation and the procedures/techniques necessary to satisfy these generic requirements are significantly different for IFR Class II navigation.

117. EQUIPMENT FOR IFR CLASS II NAVIGATION.

A. *Electronic Long-Range Navigation Systems (LRNS).* The vast majority of IFR Class II navigation operations are conducted using automatic electronic navigation systems. An automatic long-range navigation system must contain sensors that either detect motion or changes in geographic position and a computational capability that generates the guidance information necessary to adhere to the selected route centerline and determine arrival at selected waypoints. Navigation equipment must be capable of enabling the aircraft to be navigated within the constraints of the air traffic service (ATS) to the accuracy requisite for the control of air traffic. Navigation systems can consist of a single unit or a combination of various sensors and computers. These various systems are collectively referred to as area navigation, or RNAV (see also Order 8400.10, volume 4, chapter 1, section 2, paragraph 39C). Global navigation satellite system (GNSS), a space-based system (e.g., GPS), provides highly accurate coverage over most of the world. Order 8400.10, volume 4, chapter 1, sections 6 through 8 provide detailed discussion, guidance, and direction related to the specifics of each of these systems. This section provides general direction and guidance that is appropriate to all automatic pilot-operated electronic long-range navigation systems. This equipment covers a wide range of capability and sophistication. The basic types of automatic long-range navigation systems are self-contained or position fixing and described in the following subparagraphs.

B. *Self-Contained LRNS.* These systems may be approved for IFR Class II navigation operations in accordance with 14 CFR part 121, section 121.355.

(1) IRS and INS function as high precision navigation instruments, but are not position fixing devices.

(a) An INS is self-contained and does not depend on input from sources external to the aircraft. The

initial geographic position (alignment) must be inserted. The inertial sensors detect aircraft movement by measuring acceleration and velocity. These factors are applied to the initial position to calculate subsequent changes in position. The INS precisely measures any change in an aircraft's direction of flight and uses this information to determine position, ground speed, and the course to be flown to the destination airport.

(b) Since an INS is not a position fixing device, it does not have the ability to detect position errors in flight. Errors induced while inserting the initial position can remain undetected by the system. If such errors are made, navigational guidance from the system will be erroneous throughout the flight.

(c) *INS errors.* The major limitations associated with INS are related to sensor inaccuracies and the possible increase in drift rates based on flight time. Operators must develop procedures to recognize and document INS errors.

(d) *Multi-Sensors.* The more sophisticated multi-sensor equipment is seen in the advanced RNAV systems. The Flight Management System (FMS) and other multi-sensor systems are integrated systems consisting of airborne sensor, receiver, and computer with both navigation and aircraft performance databases that provide optimum performance guidance to a display and automatic flight control system. The sensors included in multi-sensor system position determination include IRS, DME/DME, GPS, and LORAN C. Using the information available from these systems, the navigation system can continuously examine its own calculations and determine their validity. If the navigation system notes a gross discrepancy, the pilot will be alerted. For more information, see AC 20-130 (as amended), Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors.

C. Non Self-Contained LRNS (Position-Fixing). These systems may be approved for IFR Class II navigation operations in accordance with section 121.389.

(1) Loran-C.

(a) An automatic Loran-C is a position fixing device. A Loran C navigation system detects the aircraft's geographic position through measurements of the signals transmitted from ground-based stations. If usable signals can be received from at least four separate ground-based stations (three lines of position, or LOPs), position ambiguity can be detected and automatically resolved by the navigation system. Since Loran-C is station-referenced, its accuracy can be affected by noise sources and signal irregularities. Since most automatic Loran-C depend upon aircraft compass input, Loran C cannot be used in areas of magnetic unreliability.

(b) The accuracy of Loran-C is not flight time-dependent. The accuracy of these systems is dependent on the signal quality, signal strength, and signal geometry (typical errors are less than 1 nm). The major limitation to the use of Loran C is inadequate signal coverage in most areas of the world. Loran C coverage is nonexistent in the southern hemisphere and only limited coverage exists in the northern hemisphere. (Reference LORAN-C ACs)

(2) *GNSS/GPS.* GPS is a satellite-based radio navigation system that uses precise range measurements from GPS satellites to determine a precise position anywhere in the world. (Define GNSS/GPS; see AC 120-29A)

(a) GPS is a four-dimensional position fixing device. This space-based system provides sufficient accuracy to permit the system to be used for Class I and Class II navigation.

(b) The major limitation of the GPS is related to loss of accuracy in some areas due to satellite failure or limited satellite coverage.

(c) A GPS approved for primary means of navigation may be used to update INS/IRS.

(d) See Order 8400.10, volume 4, chapter 1, section 1, paragraph 5D, GPS Navigation, for more detail on the operational approval and use of GPS for Class II navigation in oceanic and remote areas.

119. IFR CLASS II NAVIGATION APPROVALS.

General direction and guidance on air navigation approvals are in Order 8400.10, volume 4, chapter 1, sections 1 and 2. Specific direction and guidance for approving IFR Class II navigation is discussed in the following subparagraphs and other sections of this chapter.

A. Degree of Accuracy Required. Inspectors must determine that the navigation equipment and operational procedures/techniques used permit reliable IFR Class II navigation to the degree of accuracy required for the control of air traffic (see Order 8400.10, volume 4, chapter 1, section 1, paragraph 5E). The degree of accuracy required for any IFR Class II navigation operation must provide for the following criteria:

- Meets regulatory requirements
- Meets the standard practices in this order
- * Meets the requirements of part B of OpSpecs
- Provides accepted, safe operating practices
- Permits the safe separation of aircraft
- Assures obstacle avoidance along the route of flight
- Assures adequate protection for persons and property on the ground

- Permits reliable navigation to the intended destination and any necessary alternate or diversionary airports
- Meets Required Navigation Performance (RNP) (if applicable)

B. Airworthiness of Navigation Equipment. Inspectors must determine that any required navigation equipment is airworthy for IFR flight and installed in accordance with approved data. The operator must provide written evidence that shows that any navigation system used for IFR Class II navigation meets the requirements of the intended operation. If the operation involves flight into special areas of operations (e.g., North Atlantic Track (NAT)/Minimum Navigation Performance Specification (MNPS) airspace, Canadian MNPS airspace, Pacific Ocean airspace, Areas of Magnetic Unreliability (AMU), etc.), the operator must also provide evidence that the installed equipment is airworthy in accordance with requirements for the special areas of operations. It is imperative that the operations inspectors coordinate the installation and certification validations with the maintenance and avionics inspectors.

C. LRNS.

(1) Any intended flight or portion of a flight outside of Class I airspace requires a Class II-capable LRNS or a flight navigator, unless the aircraft position can be “reliably fixed” at least once each hour in accordance with the provisions of § 121.389. Long-range navigation systems are the primary means by which the IFR Class II navigation requirements can be met (see section 5 of this Order.)

(2) The use of LRNS or a flight navigator requires special navigation procedures/techniques.

(3) All IFR Class II navigation operations using LRNS shall use the practices and procedures recommended in AC 91-70, as amended, Oceanic Operations, or equivalent procedures. Any deviation from the procedures in AC 91-70, as amended, must be coordinated through AFS-400 navigation specialists. Inspectors must determine that these practices and procedures are included in the certificate

holder’s approved training programs and operating procedures.

121. PLOTTING AND SYSTEMATIC CROSS-CHECKING OF NAVIGATION INFORMATION.

During all phases of flight in class II navigation the standardized application of disciplined, systematic cross-checking of navigation information shall be required in each operator’s long-range navigation program. Advisory Circular 91-70, as amended, provides amplification of these procedures.

A. Plotting procedures have had a significant impact on the reduction of gross navigational errors. There is a requirement to plot the route of flight on a plotting chart and to plot the computer position, approximately 10 minutes after waypoint passage. Plotting may or may not be required, depending upon the distance between the standard ICAO ground-based NAVAIDS.

(1) Plotting procedures are REQUIRED for all turbojet operations where the route segment between the operational service volume of ICAO standard ground-based navigational aids exceeds 725 nautical miles.

(2) Plotting procedures are REQUIRED for all turboprop operations where the route segment between the operational service volume of ICAO standard ground-based navigational aids exceeds 450 nautical miles.

(3) The administrator requires plotting procedures for routes of shorter duration that transit airspace where special conditions exist, such as reduced lateral and vertical separation standards, high density traffic, or proximity to potentially hostile border areas.

B. Any existing approvals that differ from the plotting requirements in paragraph A and Class II navigation procedures should be reviewed and revised as necessary. Direction and guidance is available from the Navigation Specialists in coordination with AFS-400.

122 - 200 RESERVED.

[THIS PAGE INTENTIONALLY LEFT BLANK]

[PAGES 4-47 THROUGH 4-68 RESERVED]